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ART. XII.—*The Palaeozoic Brittle-Stars of Victoria.*

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(With Plate XI.)

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This paper completes the work of the authors on the Palaeozoic Stelleroidea, the results of their studies of the Asteroidea having been published in an earlier volume of these Proceedings (Withers and Keble, 1934).

The known Victorian Palaeozoic brittle stars before this work was undertaken numbered only four, namely:—

Species.	Reference.
<i>Protaster brisingoides</i> Gregory	.. Gregory, 1889
<i>Gregoriura spryi</i> Chapman	.. Chapman, 1907 (i)
<i>Sturtzura leptosomoides</i> Chapman	.. Ibid.
<i>Palaeocoma</i> sp.	.. Chapman, 1913

The faunal list now comprises thirteen species. Seven of these are entirely new, and two are species which have not hitherto been recognized in Victoria. The remaining four are those previously described or recorded by Gregory and Chapman; but the nomenclature of these forms has been subject to revision. The complete faunal list is now as follows:—

FORM.	HORIZON.	LOCALITY.	PAGE.
cf. <i>Aganaster gregarius</i> (Meek and Worthen)	Carboniferous ..	Mansfield ..	207
<i>Crepidosome kinglakensis</i> , sp. nov.	Silurian	Kinglake West	200
<i>Eospondylus tenuis</i> , sp. nov.	Silurian (Yarravian)	Moonee Ponds	206
<i>Furcaster bakeri</i> , sp. nov. ..	Silurian (Yarravian)	Studley Park	204
<i>F. kilmorensis</i> , sp. nov. ..	Silurian	Kilmore ..	205
<i>F. leptosomoides</i> (Chapman) ..	Silurian (Yarravian)	Moonee Ponds	206
<i>Gregoriura spryi</i> , Chapman ..	Silurian (Yarravian)	South Yarra	197
<i>Hallaster parvus</i> , sp. nov. ..	Silurian	Blue Hills, Taggerty	203
<i>Lapworthura miltoni</i> (Salter)	Silurian (including Yarravian)	Moonee Ponds, and Kinglake West	201
<i>L. pulcherrima</i> , sp. nov. ..	Silurian (Yarravian)	West Brunswick	201
<i>Sturtzaster</i> aff. <i>mitchelli</i> , Etheridge	Silurian (Yarravian)	Moonee Ponds, and Melbourne (excavations)	202
<i>Sturtzura brisingoides</i> (Gregory)	Silurian (Yarravian and Yeringian)	Moonee Ponds, and Parish of Yering	198
<i>Taeniactis yeringae</i> , sp. nov. ..	Silurian (Yeringian)	Parish of Yering	199

All the above species are classed in Schondorf's group the Auluroidea, true Ophiuroidea of Palaeozoic age being rare here as elsewhere. As with the Asteroidea, Victoria is practically the only Australian locality for Palaeozoic Brittle Stars. *Sturtzaster* (?) *mitchelli* Eth. fil. (Etheridge, 1899) from the Silurian beds of Bowning, New South Wales, is the only exception.

The best preservation of these forms is found in sandstone, though the cast has a negative character. Several are preserved in mudstone, and one in limestone. In some cases the ossicles are represented by films of limonite on the rock. This is the case with the type of *Gregoriura spryi* Chapman, and makes the interpretation of structure a difficult matter. The material was again obtained chiefly from the National Museum, Melbourne, and the Museum of the Geology School, Melbourne University.

We are indebted to Dr. E. S. Hills for the loan of specimens of *Hallaster parvus*, sp. nov., from the Silurian of Blue Hills, Taggerty; and to Miss Irene Crespin and Mr. F. Chapman for generously placing at our disposal the only Carboniferous species recorded, cf. *Aganaster gregarius* (Meek and Worthen), from Mansfield. This is the only species which is not of Silurian age.

A note should perhaps be added on the locality of certain of the specimens from the neighbourhood of Melbourne. The terms "Flemington" and "Moonee Ponds" were both used by the early Geological Survey for the one locality (B8). The term "Union St. Cliff" is also identical.

The classification adopted, as with the Asteroidea, is that of Schuchert (1915), with additional genera later erected by Spencer (1914 *et seq.*). To both these works we again record our very deep indebtedness.

Sub-Class AULUROIDEA Schondorf.

Order LYSOPHIURAE Gregory.

Family PROTASTERIDAE Miller.

Genus **Gregoriura** Chapman.

GREGORIURA SPRYI Chapman.

1889. *Protaster brisingoides* Gregory. *Geol. Mag.* (3), vi., pp. 22-24, text-fig. 3 (not text-figs. 1 and 2).

1907. *Gregoriura spryi* Chapman. *Proc. Roy. Soc. Vic.* (n.s.), xix., p. 5, pl. vi., fig. 1; pl. viii., figs. 1-3.

1915. *Gregoriura spryi* Chapman. Schuchert, *Bull.* 88, U.S. Nat. Mus., p. 233.

This species is the genoholotype and only species of the genus. For notes on the identity of certain specimens of *Protaster brisingoides* Gregory with the above form, see under *Sturtzura brisingoides*.

Associates.—*Caractacaster yarraensis*, sp. nov.; *Petraster angustior*, sp. nov. Brachiopods, pelecypods, trilobites, &c.

Horizon.—Silurian (Yarravian Series).

Locality.—South Yarra, Victoria. Type specimen No. 9105 in National Museum, Melbourne. Collected and presented by F. P. Spry.

Family PALAEOPHIURIDAE Gregory.

Genus **Sturtzura** Gregory.

STURTZURA BRISINGOIDES (Gregory).

1889. *Protaster brisingoides* Gregory. *Geol. Mag.* (3), vi., pp. 22-24, text-figs. 1, 2 (not text-fig. 3).
1897. *Sturtzura brisingoides* (Gregory). *Proc. Zool. Soc. London* for 1896, p. 1034.
1907. *Protaster brisingoides* Gregory. Chapman, *Proc. Roy. Soc. Vic.* (n.s.), xix., p. 22, pl. vi., fig. 2; pl. viii., fig. 2.
1914. *Sturtzura brisingoides* (Gregory). Schuchert, *Fossilium catalogus. Animalia*, pt. 3, pp. 35, 41, 42.
1915. *Sturtzura brisingoides* (Gregory). Schuchert, *Bull.* 88, U.S. *Nat. Mus.*, p. 236.
1927. *S. brisingoides* (Gregory). Spencer, Monograph of British Pal. Asterozoa, *Mem. Pal. Soc.* for 1925, p. 366. Text-figs. 232b, 233b.

A good deal of confusion has arisen over the nomenclature of this genus (*vide* Spencer, *loc. cit. supra*, p. 365). The original material from Moonee Ponds was described by Gregory in 1889 as a species of *Protaster*. In 1897, he made it the type of the new genus *Sturtzura*. The next investigator was Chapman, who, working in Australia on a large collection of similar material in 1907, showed that the genus *Sturtzura* had been founded on misinterpretation of the specimens. Chapman showed that the specimens were negatives of the original form, and that the true structure was that of *Protaster*, the genus in which Gregory first placed it. Spencer, investigating the type material in the British Museum in 1927, re-instituted the name *Sturtzura*, apparently regarding the ossicles as sufficiently distinct from *Protaster* to warrant this. His figures make it clear that he appreciates the negative character of the specimens. We have therefore followed him in reverting to *Sturtzura*. We think however that he has misinterpreted parts of Chapman's work. It is not correct to say that "Chapman decided that Gregory's specimens represented more than one species." (p. 365). Chapman merely renamed Gregory's specimens from the Silurian of Moonee Ponds as *P. brisingoides*, which is the first species he refers to in his 1907 paper. The second species (described as *Gregoriura spryi*) was not known to Gregory, the specimens being discovered at a later date and from a different locality, though from the same horizon. Neither did he know the third species, *Sturtzura leptosomoides*, though from the same locality and horizon as *P. brisingoides*. Mr. Chapman, in a personal communication, states he would not be prepared to identify Gregory's figure 3 (which is of mouth part only), with *Gregoriura spryi*, for he has found considerable variation in the mouth part of *S. brisingoides*. As, however,

Dr. Spencer refers to a difference in the vertebra of the type specimens on which figure 3 is based compared with those for figures 1 and 2, we must leave that point to him.

S. brisingoides has no real relationship with *Furcaster leptosoma* (Salter), which was named by Gregory *Sturtzura leptosoma*; nor with the corresponding Australian species, *Sturtzura leptosomoides* Chapman. The differences between *Furcaster leptosomoides* and *Sturtzura brisingoides* were clearly brought out by Chapman in 1907 (*loc. cit.*, pl. 8).

Associates.—*Petraster smythi* McCoy; *Promopalaeaster meridionalis* (Eth. fil.); *Camarotoechia decemplicata* (Sow.), &c.

Horizon.—Silurian (Yarravian Series).

Locality.—Near Flemington, Victoria.

Family TAENIACTINIDAE Spencer.

Sub-Family TAENIACTINAE Spencer.

Genus **Taeniactis** Spencer.

TAENIACTIS YERINGAE, sp. nov.

(Text-fig. 1.)

1913. *Urasterella* sp. Chapman, F., *Aust. Assoc. Adv. Sci.*, xiv., p. 223.

Description.—Five long slender and slowly tapering arms radiating from a circular disc. The plates of the disc vary in both size and shape, and are irregularly arranged. The boundary of the disc is convex, but this may be due to post-mortem distortion. For the same reason, the original size of the disc is uncertain. Ambulacral plates opposite and quadrate with a prominent ridge bordering the thread-like ambulacral channel and a less prominent transverse ridge situated medially. The two ridges thus form a T. Adambulacrals elongate, sub-rectangular and tumid, outer edge slightly concave; inner edge bearing a prolongation opposite the transverse ridge on each ambulacral. The point of attachment of a spine can be seen on the outer edge of some of the adambulacrals. Mouth angle plates elongate and curved. Apical side unknown.

Dimensions.—Greatest length of arm preserved 17 mm.; apparent radius of disc 6 mm.

Remarks.—This interesting form is the first stelleroid described in the Yeringian series of the Victorian Silurian. The two specimens on which it is based were discovered by the Geological Survey of Victoria in 1862. They were referred to by Chapman (1907 (i), p. 23), and recorded by him in 1913 (p. 223), as *Urasterella* sp. The arrangement of the ossicles, however, and the existence of the central disc free from the arms class the form as a brittle star. The elongate adambulacrals, and the subquadrate ambulacrals, with the T-shaped ridge, show close relationship with the Wenlock species *Taeniactis wenlocki* Spencer, from Pentland Hills, Scotland. (Spencer, 1927, p.

380, pl. xvii., figs. 4, 5; text-figs. 245-247). *T. yeringae* is a larger form with slightly stouter adambulacrals. There are also differences in the disc structure. The boundary in *T. wenlocki* is concave; but in *T. yeringae* it is convex. Little dependence can be placed on this, however, for it has been largely determined by post-mortem distortion.

Horizon.—Silurian (Yeringian Series).

Locality.—Section 12, Parish of Yering; Geol. Surv. Locality B15. Specimens in National Museum, Melbourne, Nos. 13827 (holotype) and 13828 (topotype).

Family ENCRINASTERIDAE Schuchert.

Sub-Family EUZONOSOMATIDAE Spencer.

Genus **Crepidosoma** Spencer.

CREPIDOSOMA KINGLAKENSIS, sp. nov.

(Pl. XI., fig. 3. Text-figs. 2, 3.)

1933. *Palaeaster* sp. nov. (nomen nudum), Withers, *Proc. Roy. Soc. Vic. (n.s.)*, xlv. (1), p. 21.

Description.—Five short straight arms, broadest at disc margin, thence tapering to a finely drawn-out extremity. Disc circular, relatively large, extending about one-third of the distance along the arms, margined by a ring of rectangular plates with convex surfaces, at least six plates in each interradius. Orally, the ambulacrals are elongate rectangular; apically they are quadrate. Adambulacrals convex, large, almost elliptical in shape, except that extremities are angular; with major axis inclined to axis of arm. Mouth frame composed of long slender bars in apical view, but orally they appear stouter.

Dimensions.—Holotype, $R = 10$ mm.; $r = 2.5$ mm.

Remarks.—The specimens comprise a negative of the oral side, very well preserved (holotype), and one of the apical side, in which the arms are incomplete but the mouth frame shows clearly (paratype). All the essential features of *Crepidosoma* are present; but our species is only half the size of the corresponding Wenlock species of Scotland, *Crepidosoma wenlocki* Spencer. (Spencer, 1930, p. 430, pl. 27, figs. 1, 2, 7; text-figs. 276, 277). *C. wenlocki* has only three marginal plates in each interradius. Otherwise the British form shows very close correspondence to the Australian.

Associates.—*Lapworthura miltoni* (Salter); *Schuchertia junori* Withers and Keble; *Rutroclypeus junori* Withers.

Horizon.—Silurian.

Locality.—Collin's Quarry, Kinglake West, Victoria. Specimens presented to National Museum by their finder, Mr. P. Junor. Nos. 13831 (holotype) and 13832 (paratype).

Order STREPTOPHIURAE Bell.

Family LAPWORTHURIDAE Gregory.

Genus **Lapworthura** Gregory.

LAPWORTHURA MILTONI (Salter).

(Pl. XI., fig. 4.)

1925. *Lapworthura miltoni* (Salter). Spencer, *Mem. Pal. Soc.*, pp. 302-309, pl. i., figs. 9, 10; pl. xix., figs. 3-6; pl. xx., figs. 2, 3; pl. xxi., figs. 7, 8; Text-figs. 175, 188-191, 203-205.

The full synonymy is given in the above paper. Two specimens are known from Victoria. One (from Kinglake) is a mould of the oral side preserved in a hard greenish sandstone. Only one arm is fully preserved, and this is about 2.5 cm. in length. In England, the form ranges from the Upper Ordovician to the Ludlow, the Ordovician specimens generally being smaller than the Silurian. The Kinglake specimen is nearly as small as the minimum size known from the Ordovician. The second specimen (from Moonee Ponds) is a single incomplete arm 3 cm. in length.

Associates.—*Schuchertia junori* Withers and Keble; *Rutro-clypeus junori* Withers (Kinglake); *Promopalaeaster meridionalis* (Eth. fil.); *Petraster smythi* McCoy; &c., (Moonee Ponds).

Horizon.—Silurian; also Silurian (Yarravian Series).

Locality.—Collin's Quarry, Kinglake West, Victoria. The specimen (No. 13833) was found by Mr. P. Junor and donated by him to the National Museum; also known from Moonee Ponds Creek. (Specimen No. 1035, Geology School, University of Melbourne).

LAPWORTHURA PULCHERRIMA, sp. nov.

(Pl. XI., figs. 1, 2. Text-figs. 4, 5.)

Description.—Five short flexible petaloid arms. Apically the arms have a prominent double row of alternate ambulacrals forming a central ridge. Each ossicle closely resembles a knuckle-bone; it is quadrate with concave boundaries, the outer lateral concavity being the deepest; and has a broad, well-marked transverse groove. Orally, the ambulacrals are boot-shaped, the lateral distal corner being deeply excavated for the ventral longitudinal muscle. Adambulacrals viewed from apical side elongate sub-rectangular, and set obliquely to axis of the arm. The proximal edge of the rectangle is modified so as to rise to a low point in the middle. The outer end of the adambulacral is tapered. Orally the ambulacrals are more slender than apically, and are approximately L-shaped. The L consists

of a sharp ridge set obliquely to the ambulacrals, joined laterally to a stouter piece making an obtuse angle with the first. Attached to the latter are slender, oblique spines of length about equal to adambulacrals. Frame composed of narrow and high mouth angle plates.

Dimensions.—Syntypes:—Length of arm, 10 mm.; maximum width of arm (in middle), 3 mm.; diameter of oral pentagon, 2.5 mm.

Remarks.—In size, and in the petaloid form of the arms this species is like *Furcaster leptosomoides* (Chapman), which is found in neighbouring beds. The subquadrate shape of the ambulacrals (in apical view) clearly indicates however that it is *Lapworthura*. Further the arms are relatively flat, the mouth structure not sufficiently acute for *Furcaster* and the spines not parallel with the arms. From *Lapworthura miltoni*, the only other species of this genus, the form is distinguished by the more transverse side shields, and the petaloid arms. *L. miltoni* ranges from the Upper Ordovician to the Ludlow in Great Britain.

Associates.—*Cyphaspsis spryi* Gregory; *Encrinurus (Cromus) spryi* Chapman. Less than a quarter of a mile away the types of *Furcaster leptosomoides* (Chapman); *Sturtzura brisingoides* (Gregory); *Petraster smythi* McCoy were obtained.

Horizon.—Silurian (Yarravian Series).

Locality.—Dawson-street, West Brunswick, about $\frac{1}{4}$ mile north of the Geological Survey of Victoria Locality "Flemington" (B8). Specimen found by D. McCance, Esq., and now in Museum of Geology Department, University of Melbourne. Syntypes:—No. 1157, apical specimen; and No. 1500, oral specimen (counterpart).

Genus **Sturtzaster** Etheridge.

STURTZASTER aff. MITCHELLI Etheridge.

1913. *Palaeocoma* sp. Chapman, *Aust. Assoc. Adv. Sci.*, xiv., p. 214.

The name *Sturtzaster* was proposed by Etheridge (1899, p. 129) for the genus *Palaeocoma* Salter (1857, pp. 324-327). The latter name, he pointed out, had already been used by d'Orbigny (1850, p. 240) as a new generic name for *Ophiura mulleri* Phillips, a distinct type of brittle-star from the Lias. *Palaeocoma marstoni* Salter has become the genotype of *Sturtzaster*. The genus has a large disc which has caused some authors to place it among the Asteroids, but the long slender spines and the ambulacral characters show it is an Auluroid. The two Victorian specimens are not well preserved, but they both have a large disc, subquadrate ambulacrals, large quadrate adambulacrals, and long spines on the margins of the disc and

arms. These features are sufficient to show a relationship with *Sturtzaster* (?) *mittchelli* Etheridge, though we have not been able to examine the type specimen of the latter. *S.* (?) *mittchelli* occurs in the Silurian (Wenlock) beds at Bowning, N.S.W.

Horizon.—Silurian (Yarravian Series).

Locality.—Swanston-street, Melbourne (excavations), No. 13835, presented by Mr. F. P. Spry. Also Moonee Ponds, No. 13836. Both specimens in the National Museum, Melbourne.

Genus **Hallaster** Sturtz.

HALLASTER PARVUS, sp. nov.

(Pl. XI., figs. 5, 6. Text-figs. 8, 9.)

1929. *Taeniaster* (?) aff. *spinus* Billings. E. S. Hills, *Proc. Roy. Soc. Vic.* (n.s.), xli., p. 179.

Description.—A small species with five short, petaloid arms. Only faint traces of the central disc preserved. Orally the arms are high, and have two central columns of sub-quadrate plates with the outer distal side scooped so as to resemble a stout boot. The side plates are first narrow then broader, slightly curved and set obliquely to the axis of the arm. No spines were observed. Apically the ambulacral plates unite in a low central ridge. They are sub-quadrate. Side plates similar to apical view. Oral armature made of stout sub-triangular plates; but not well preserved.

Dimensions.—Syntypes :—R = about 5 mm.; r, indeterminate.

Remarks.—The species bears quite a strong resemblance to *Taeniaster spinus* Billings (Billings, 1858, p. 81, pl. 10, figs. 3 a-d; Schuchert, 1915, p. 219, pl. 36, fig. 1; text-fig. 17); but is distinctly smaller. The ambulacrals in apical view, and the side plates are also stouter. In these respects *T. parvus* resembles *Hallaster cylindricus* (Billings) (Spencer, 1925, p. 291, pl. 19, figs. 1, 2; pl. 21, figs. 1-5; text-figs. 178, 179, 198-201), originally described by Billings as *Taeniaster cylindricus*. *H. cylindricus* exhibits the asteroid-like oral armature which is a rather striking feature of our species. This structure is not well preserved, so that the exact details cannot be made out. It is also possible that the stout appearance is due to a foreshortening of the plates. (Spencer, *loc. cit.*, p. 294). *T. spinus* occurs in the Middle Ordovician (Trenton Limestone); *H. cylindricus* is found in Canada, U.S.A., and Scotland, and ranges from the Middle Ordovician to the Lower Devonian.

Associates.—*Orthis* (*Dalmanella*) *testudinaria* Dalman; *Coleolus* cf. *aciculum* J. Hall, &c.

Horizon.—Silurian.

Locality.—Blue Hills, Taggerty. Specimens (counterparts) collected by Dr. E. S. Hills in 1929; now in collection of Geological Department, University of Melbourne. Syntypes: Nos. 792 (oral), No. 793 (apical).

Genus **Furcaster** Sturtz.

FURCASTER BAKERI, sp. nov.

(Pl. XI., figs. 9, 10. Text-figs. 10, 11.)

Description.—Five small flexible arms emanating from a small central disc and tapering only slowly. The oral aspect of arms shows a central row of alternating hatchet-shaped ambulacrals, the broadest part of each ambulacral adjoining the median line of the arm. Adambulacrals sub-rectangular but tapering laterally, arranged obliquely with outer tips pointing distally. Apically the ambulacrals are much excavated; for the most part they are thin slabs laid end to end. The only prominent part is a ridge which broadens near the axis of the arm. Adambulacrals in apical view appear as elongate tapering plates bordering the arm, each with a lateral process opposite the ridge on the corresponding ambulacral. Mouth frame not preserved. Spines on side plates not observed.

Dimensions.—Syntypes:—Greatest length of arm, 7 mm.; greatest width of arm, 1.5 mm. Diameter of oral pentagon about 3 mm.

Remarks.—The specimens comprise the mould of the oral side in sandstone, and its counterpart which is a mould of the apical side. Apically the ambulacrals resemble closely those of *Furcaster leptosoma* (Salter), from the Lower Ludlow of England (Spencer, 1925, p. 320, text-figs, 211), the characteristic median ridge being clearly discernible. Orally they differ from all other species of *Furcaster*. In place of the typical boot-shape, they are hatchet-shaped; that is, the excavation for the dorsal longitudinal muscle eats into the proximal edge of one ossicle and the distal edge of the adjoining ossicle, instead of into the distal edge of each ossicle. The ossicles of *F. bakeri* are thus a link between those of *Hallaster* or *Lapworthura* and those of the typical *Furcaster*. *F. bakeri* is smaller than *F. leptosomoides* (Chapman), and smaller again than *F. kilmorensis*; and its arms are not petaloid as in these two species. It is distinguished from *Lapworthura pulcherrima*, sp. nov. by the absence of the long oblique spines (of generic importance), the more excavated ambulacrals, and its smaller size. The arms have been preserved in an attitude indicative of its wriggling mode of progression. An unpaired arm is thrust out to the rear; and this has to either side, first a slightly curved arm, and then one of the forward arms strongly retroflexed (see Pl. XI., figs. 5, 6).

Associates.—Fossils from the same locality, though not the same bed are *Camarotoechia decemplicata* (Sow.); *Monograptus chimaera*; *M. roemeri*; *M. colonus*; *M. varians* (all Ludlovian.)

Horizon.—Silurian (Yarravian).

Locality.—East side of new Yarra Boulevard, vicinity of Dight's Falls, Studley Park. The specimen was not *in situ*. Collected by G. Baker, Esq. Museum of Geology School, University of Melbourne, Nos. 1498 (oral), 1499 (apical).

FURCASTER KILMORENSIS, sp. nov.

(Pl. XI., fig. 8. Text-figs. 6, 7.)

Description.—Five moderately long arms; orally, when the groove is open, they are petaloid, but apically they are straight and slender. The oral surface is composed of two rows of boot-shaped ambulacrals, arranged slightly alternately. The back of the boot faces proximally; the toe distally. Adambulacrals rectangular, with a prominent Γ -shaped ridge. The horizontal portion of the ridge is first thin, becoming stouter as the lateral portion is approached. The latter, which is directed distally, is both thick and prominent. No spines were observed. Apically the ambulacrals form a high ridge; they appear subquadrate with the median and lateral boundaries concave; the adambulacrals are also quadrate, and bear a prominent ridge similar to that seen orally. Mouth frame petaloid and acute, made of five pairs of first ambulacrals surmounted by five pairs of slender mouth angle plates.

Dimensions.—Holotype:—Length of complete arm, 20 mm.; greatest width of arm, 2.5 mm. (groove open). Paratype: Width of arm, 2 mm.; diameter of oral pentagon, 4.5 mm.; arms incomplete. Other specimens are only slightly smaller or slightly larger.

Remarks.—The holotype is a preservation of the oral side with the groove wide open; the paratype shows the apical side, including an excellent view of the mouth parts. *Furcaster kilmorensis* is a larger species than *F. leptosomoides*. It most closely resembles *F. leptosoma* (Salter), which is found in Great Britain and Europe in rocks of Upper Ordovician to Carboniferous age. Our specimens, however, are most like those from the Lower Ludlow beds of England, which they resemble in size and disposition of arms. They differ in having petaloid arms, in lacking the thin transverse ridge on the ambulacrals, in the alternate arrangement of the latter and in consequence the absence of the well-marked hollow between apical naives of the vertebral ossicles.

Associates.—The specimens come from the same district as *Salteraster schwyni* (McCoy), and *Salteraster biradialis* Withers and Keble, but not the precise locality, for the matrix is a yellow sandstone, while in the latter cases it was red.

Horizon.—Silurian.

Locality.—Kilmore, Victoria. Collected and presented by G. Sweet, Esq., to National Museum, Melbourne. Holotype No. 13829, paratype No. 13830.

FURCASTER LEPTOSOMOIDES (Chapman).

1907. *Sturtzura leptosomoides* Chapman. *Proc. Roy. Soc. Vic.* (n.s.), xix., p. 26, pl. vii., figs. 1, 2; pl. viii., fig. 4.

The genus *Furcaster* was erected by Sturtz in 1886 to receive a species (*F. palaeozoicus*) from the Lower Devonian of Germany. Since then, members of the genus have been recorded from horizons ranging from the Lower Silurian to the Lower Carboniferous in England, Europe, and America. The form is extraordinarily variable in size, and as a result has been described under a number of generic and specific names. In 1925, however, Spencer (pp. 312-326) made an exhaustive study of the genus, and among other things, placed *Sturtzura leptosoma* (Salter), in the genus *Furcaster*. Hence the change in name in the Victorian form, which is certainly congeneric with Salter's species from the Lower Ludlow.

Associates.—*Petraster smythi* McCoy; *Promopalaeaster meridionalis* (Eth. fil.), &c.

Horizon.—Silurian (Yarravian Series).

Locality.—Moonee Ponds Creek, Flemington. (Geol. Surv., Locality B8).

Family EOLUIDIIDAE Gregory.

Genus **Eospondylus** Gregory.

EOSPONDYLUS TENUIS, sp. nov.

(Pl. XI., fig. 7. Text-fig. 12.)

Description.—Arms five, flexuous, exceedingly slender. Each half of a vertebra has the appearance of a long boot, the back of the boot facing towards the tip of the arm. Side plates very small, and round, close to vertebrae, and bearing long slender spines set almost at right angles to axis of the arm. Disc probably large, consisting of squamose granulate plates. Mouth frame large.

Dimensions.—Length of arms uncertain, the parts preserved projecting little beyond the disc. Radius of disc (approximately), 7.5 mm.; width of arm, 1 mm.

Remarks.—The specimen comprises part of a disc and portions of each arm (oral side). The only species of the genus *Eospondylus* known from elsewhere is *E. primigenius* (Sturtz), from the Lower Devonian of Bundenbach, Germany (Spencer, 1925, p. 309, pl. 21, fig. 9; text-figs. 206 *a-e*). *E. primigenius* is a larger species than *E. tenuis*, the ventral ossicles are stouter, and the side plates more prominent.

Horizon.—Silurian (Yarravian Series).

Locality.—Moonec Ponds. Specimen found by Dr. E. S. Hills in 1926; now in the collection of the Geological Department, University of Melbourne, No. 1497. Holotype.

Family AGANASTERIDAE Sturtz.

Genus **Aganaster** Miller and Gurley.

cf. AGANASTER GREGARIUS (Meek and Worthen).

1915. *Aganaster gregarius* (Meek and Worthen). Schuchert, *Bull.* 88, *U.S. Nat. Mus.*, p. 264.

1925. *Aganaster gregarius* (Meek and Worthen). Spencer, *Mon. Pal. Asterozoa*, pt. 6. *Mem. Pal. Soc.* for 1922, p. 285, pl. 18, fig. 3; pl. 20, figs. 4, 5, 6; text-figs. 194, 195.

The Victorian specimens of this form are poorly preserved in a hard chocolate sandstone. Five very slender arms radiate from a small central disc. The arm structure consists of a double row of rectangular to sub-quadrate plates, as in *A. gregarius*. Another character which assists in identification is the gregarious nature of the form. In many British and American specimens the rock is crowded with a large number of small forms. In our specimen there are three tiny forms not more than an inch away from each other.

The American examples are from the Keokuk formation (Lower Carboniferous) of Indiana, U.S.A. The disc in these specimens varies from 3-7 mm., and the longest arm is 15 mm. The British specimens, from the Lower Carboniferous of Ardross, Fife, are smaller (R:r:: 6 mm.; 1 mm. maximum, with many specimens only half as large).

This is the first stelleroid identified from the Victorian Carboniferous.

Dimensions.—Maximum length of arm preserved, 3.5 mm.; diameter of disc about 1 mm.

Horizon.—Carboniferous.

Locality.—At back of homestead, Maindample Park, Mansfield, Victoria. The specimen was discovered by Miss Irene Crespin, B.A., and presented by her to the National Museum. No. 13834.

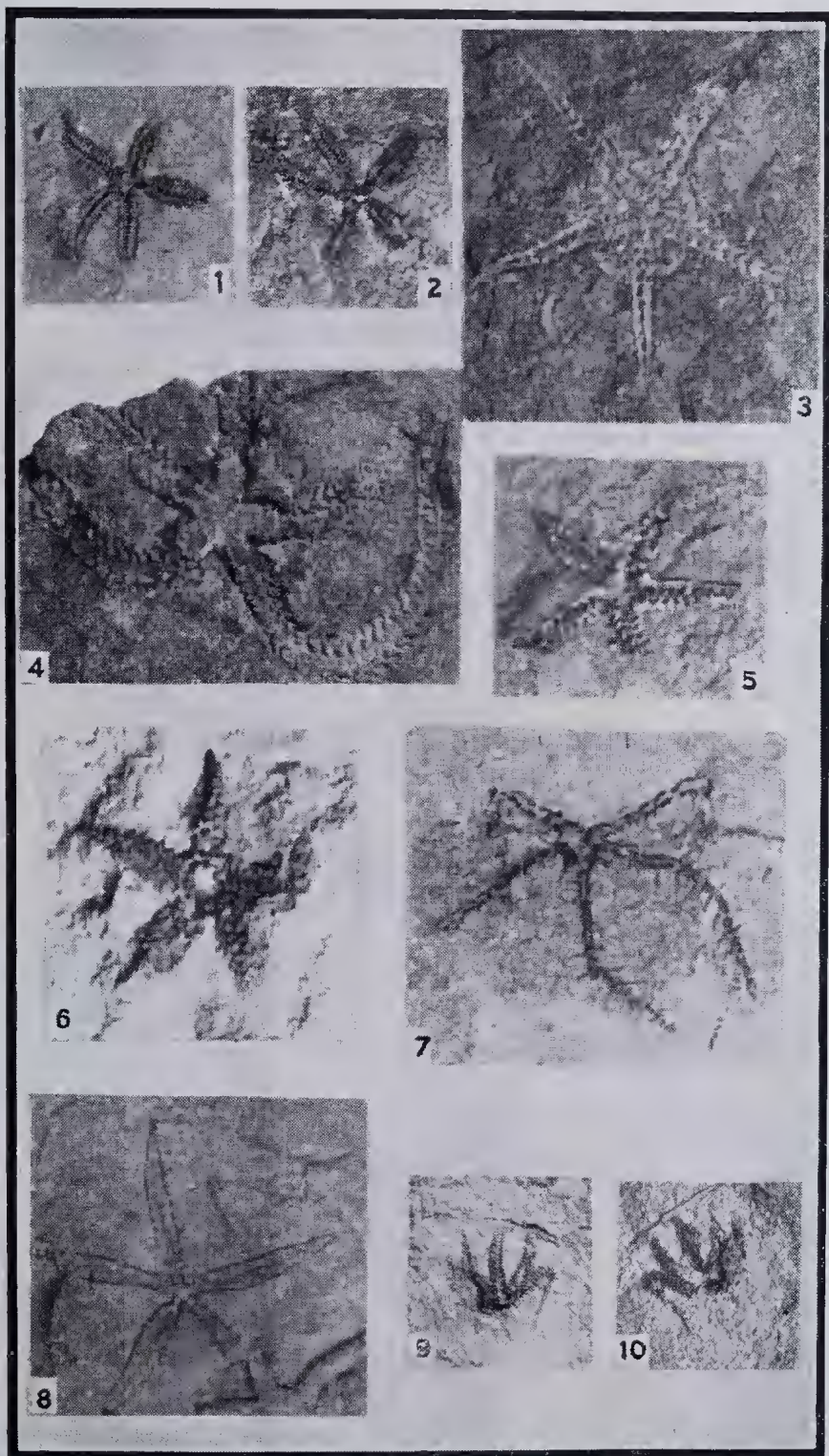
References.

- BATHER, F. A., 1907. Australian Palaeontologist on Silurian Ophiuroids. *Geol. Mag.* (5), iv., pp. 313-314.
- BILLINGS, E., 1858. On the Asteriadae of the Lower Silurian Rocks of Canada. *Geol. Surv. Canada. Canadian Organic Remains*, dec. 3, pp. 75-85.
- CHAPMAN, F., 1907 (i). New or little-known Victorian Fossils in the National Museum, Pt. 8. Some Palaeozoic Brittle Stars of the Melbournian Series. *Proc. Roy. Soc. Vic.* (n.s.), xix., (2), pp. 21-27, pl. vi-viii.
- , 1907 (ii). Nomenclature of the Australian Ophiuroids. *Geol. Mag.* (5), iv., p. 479.
- , 1913. On the Palaeontology of the Silurian of Victoria. *Aust. Assoc. Adv. Sci.*, xiv., p. 214.
- ETHERIDGE, R., jr., 1899. On the Occurrence of a Starfish in the Upper Silurian Series of Bowring, New South Wales. *Rec. Aust. Mus.*, iii., No. 5, pp. 128-129.
- GREGORY, J. W., 1889. On a New Species of the Genus *Protaster* (*P. brisingoides*) from the Upper Silurian of Victoria, Australia. *Geol. Mag.* dec. 3, vi., pp. 24-27, woodcut.
- , 1897. On the Classification of the Palaeozoic Echinoderms of the Group Ophiuroidea. *Proc. Zool. Soc. London* for 1896, pp. 1028-1044, text-figs.
- D'ORBIGNY, A. D., 1849. *Prodrome de Paléontologie*, vol. 1.
- SALTER, J. W., 1857. On some new Palaeozoic Starfishes. *Ann. Mag. Nat. Hist.* (2), xx., pp. 321-334, pl. ix.
- SCHUCHERT, C., 1915. Revision of the Palaeozoic Stelleroidea with special reference to the North American Asteroidea. *U.S. Nat. Mus., Bull.* 88.
- SPENCER, W. K. A Monograph of the British Palaeozoic Asterozoa. *Mem. Pal. Soc.*
- 1925 (issued for 1922), Pt. VI., pp. 237-324, text-figs. 172-212, pl. 18-22.
- 1927 (issued for 1925), Pt. VII., pp. 325-388, text-figs. 213-248, pl. 23-24.
- 1930 (issued for 1928), Pt. VIII., pp. 389-436, text-figs. 249-280, pl. 25-28.
- WITHERS, R. B., and KEBLE, R. A., 1934. The Palaeozoic Starfish of Victoria. *Proc. Roy. Soc. Vic.* (n.s.), xlvi. (2), pp. 220-249, pl. x.-xiii., text-figs. 1-10.

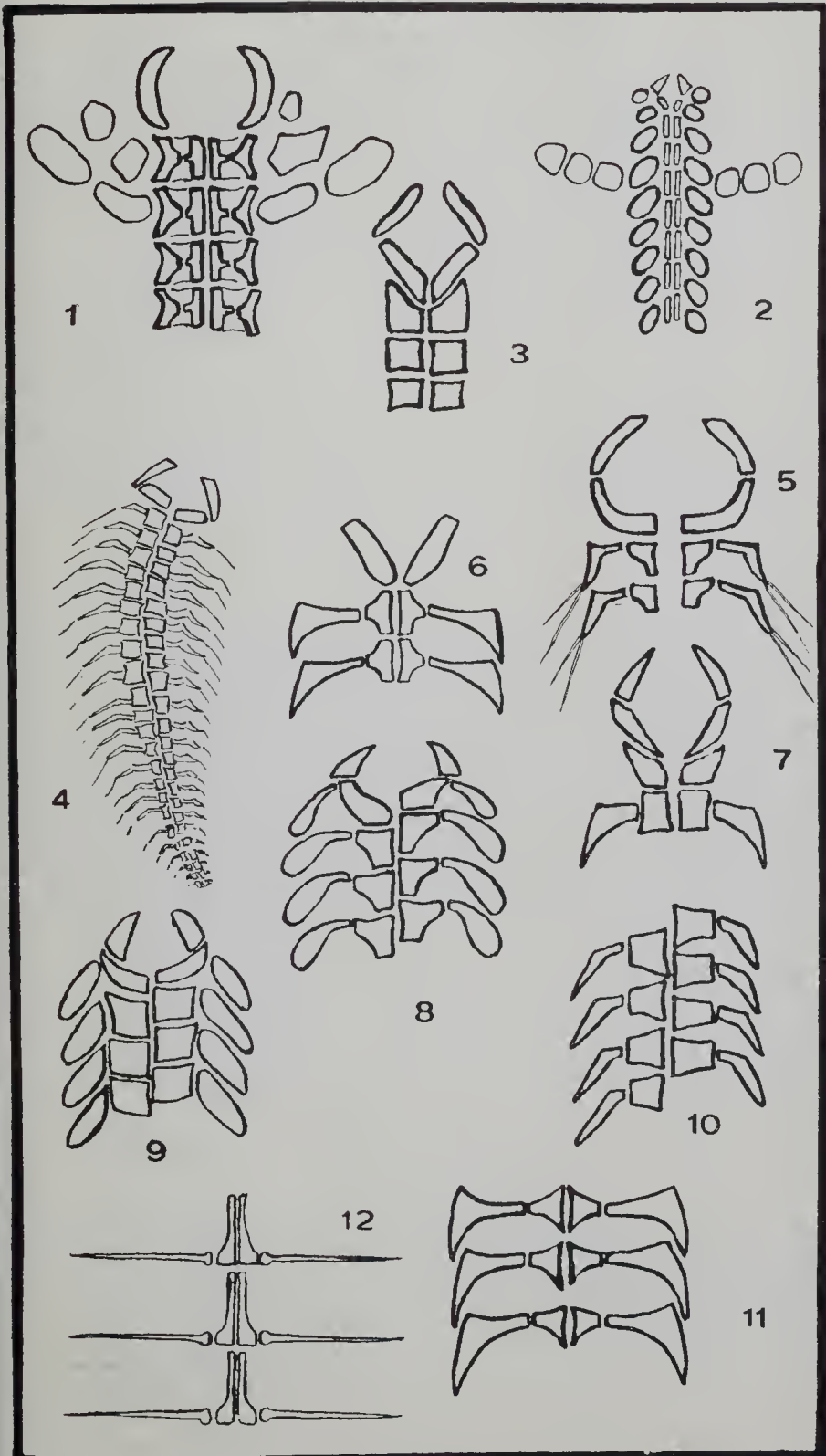
Explanation of Plate XI.

(NOTE.—All specimens of Silurian age, except *Aganaster* (Carboniferous)).

- Fig. 1.—*Lapworthura pulcherrima*, sp. nov. Apical side of syntype. $\times 1.5$. West Brunswick. Coll. by D. McCance, Esq. Mus. of Geol. School, Univ. of Melb., No. 1157.
- Fig. 2.—*L. pulcherrima*, sp. nov. Oral view of syntype. $\times 1.5$. West Brunswick. Coll. by D. McCance, Esq. Mus. of Geol. School, Univ. of Melb., No. 1500.
- Fig. 3.—*Crepidosomea kinglakensis*, sp. nov. Oral view of holotype. $\times 2.5$. Kinglake West. Coll. by P. Junor, Esq. Nat. Mus. Coll., No. 13831.



Palaeozoic Brittle-Stars.



TEXT FIGS. 1-12.

- Fig. 4.—*Lapworthura miltoni* (Salter). Oral view. $\times 2$. Kinglake West. Coll. by P. Junor, Esq. Nat. Mus. Coll., No. 13833.
- Fig. 5.—*Hallaster parvus*, sp. nov. Oral view of syntype. $\times 4.5$. Blue Hills, Taggerty. Coll. by Dr. E. S. Hills. Mus. of Geol. School, Univ. of Melb., No. 792.
- Fig. 6.—*H. parvus*, sp. nov. Apical view of syntype. $\times 4.5$. Blue Hills, Taggerty. Coll. by Dr. E. S. Hills. Mus. of Geol. School, Univ. of Melb., No. 793.
- Fig. 7.—*Eospondylus tenuis*, sp. nov. Oral view of holotype. $\times 4$. Moonee Ponds. Coll. by Dr. E. S. Hills. Mus. of Geol. School, Univ. of Melb., No. 1497.
- Fig. 8.—*Furcaster kilmorensis*, sp. nov. Oral view of holotype. $\times 1.5$. Kilmore. Coll. by G. Sweet, Esq. Nat. Mus. Coll., No. 13829.
- Fig. 9.—*Furcaster bakeri*, sp. nov. Oral view of syntype. $\times 1$. Studley Park. Coll. by G. Baker, Esq. Mus. of Geol. School, Univ. of Melb., No. 1498.
- Fig. 10.—*F. bakeri*, sp. nov. Apical view of syntype. $\times 1$. Studley Park. Coll. by G. Baker, Esq. Mus. of Geol. School, Univ. of Melb., No. 1499.

TEXT FIGURES 1-12.

(1) *Taeniactis yeringae*, sp. nov. Oral view of mouth structure, disc, and part of arm. $\times 3\frac{1}{2}$. (2, 3) *Crepidosome kinglakensis*, sp. nov.: (2) Oral view of mouth structure, disc and part of arm. $\times 3\frac{1}{2}$. (3) Apical view of same. $\times 3\frac{1}{2}$. The oral groove is closed so that side plates have moved almost entirely to that side. (4, 5) *Lapworthura pulcherrima*, sp. nov.: (4) Apical view of arm. $\times 5$. (5) Oral view of mouth parts and portion of arm, with spines. $\times 9$. (6, 7) *Furcaster kilmorensis*, sp. nov.: (6) Oral view of part of arm and mouth structure (latter imperfect). $\times 7$. (7) Apical view of mouth structure and part of arm. $\times 7$. Figured from paratype—No. 13830. Nat. Mus. Melb., of which no photograph is given. (8, 9) *Hallaster parvus*, sp. nov.: (8) Oral view of mouth structure and part of arm. $\times 17$. (9) Apical view of same. $\times 17$. (10, 11) *Furcaster bakeri*, sp. nov.: (10) Oral view of mouth structure and part of arm. $\times 14$. (11) Apical view of same. $\times 17$. (12) *Eospondylus tenuis*, sp. nov. Oral view of mouth structure and part of arm. $\times 14$.